

13.—A record of Foraminifera from Oyster Harbour, near Albany, Western Australia

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One hundred and thirty-four species of foraminifera from Oyster Harbour are identified, and a partial synonymy, together with a brief discussion, is given for each species.

Occurrences are recorded by samples in a table as percentages of total foraminifera populations, sample locations being shown on a map.

An indication is given of the ecological significance of this microfauna.

Introduction

Although several shallow water faunas of foraminifera have been described from the Southern Ocean off south-eastern Australia (Parr 1932a, 1932b, 1945, 1950; Chapman 1941), Western Australian records of similar faunas are rare (Chapman and Parr 1935; Parr in Fairbridge, 1950; Logan 1959), and are practically non-existent for the south coast west of Longitude 124° 40' E. In this paper the foraminiferal fauna of one hundred and twenty sediment samples from Oyster Harbour, a drowned estuary near Albany, Western Australia, is described.

The samples were collected during March 1960, from the shore and bottom of the Harbour, at depths up to forty-four feet (over seven fathoms), which was the maximum depth recorded in the Harbour. A grab sampler was used for all bottom samples.

Sample locations were fixed either by taking compass bearings from the stations to several prominent points around the Harbour and reversing these bearings when plotting stations on the map, or by direct plots from aerial photographs (Figure 1).

The samples were prepared either by dry-sieving portions of 50g dry weight in a Rotap machine for ten minutes, or by wet sieving. Of the resultant fractions only those retained on the 115 Tyler sieve (125 microns) and coarser sieves were examined, experience having shown that the finer fractions contained few identifiable foraminifera.

Generally, between one hundred and two hundred specimens were counted per sample. In four samples, however, no foraminifera were found, and in some others the faunas were so impoverished that it was not possible to count this number of specimens. In other cases, where samples were rich in foraminifera, larger counts were made. The abundance of each species recorded in a sample was calculated as a percentage on the basis of the number of specimens counted in that sample. In calculating these percentages, an accuracy of better than one percent was not considered significant, and the

letter "t" was used for fractions less than this. For some samples exaggerated percentages were obtained due to the paucity of the fauna (Table I).

As the source area of the Oyster Harbour sediments includes rocks of Eocene age, the possibility exists that part of the material dealt with in this paper is fossil. Such fossil specimens however, if present, could be expected to appear more worn than living ones, but the only specimens showing signs of wear in Oyster Harbour are those from near the southern entrance, where such attrition is explained by movement back and forth in response to tidal forces where these are greatest.

Synonymy and Discussion

The beautifully-figured monographs of Brady (1884) and Heron-Allen and Earland (1915), provide valuable guides to the identification of the species; and to ensure that the nomenclature was up to date the author consulted Thalmann (1932), Ellis and Messina (1940 *et seq.*) and other available literature. Since the submission of this paper the author has been able to consult Barker (1960), and has brought the nomenclature into line with this reference, as indicated in the text. The changes made should be considered when consulting the Table where they have not been incorporated.

In Table I the species are placed in families according to the classification of Loeblich and Tappan (1961). The order of species in the Table is that followed below.

A partial synonymy is given for each species, restricted to the original record and others which, when possible, refer to an occurrence of the species in southern Australian waters. The original records are cited *vide* Ellis and Messina (1940 *et seq.*).

A brief discussion, dealing with the distribution of the species in southern Australian waters, where this is known, and in some cases extending to the environment it favours and other data of interest, follows the synonymy of each species.

Glomospira gordialis (Jones and Parker)

Trochammina squamata Jones and Parker var. *gordialis* Jones and Parker 1860, p. 304.

Ammodiscus gordialis (Jones and Parker); Brady 1884, p. 333, Plate XXXVIII, Figs. 7-9; Heron-Allen and Earland 1915, p. 618, Plate XLVI, Fig. 26.

Glomospira gordialis (Jones and Parker); Thalmann 1932, p. 300.

The Oyster Harbour specimens agree well with Brady's figures. It is noted that Brady only records the species from depths in excess of

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OYSTER HARBOUR - SAMPLE LOCATIONS

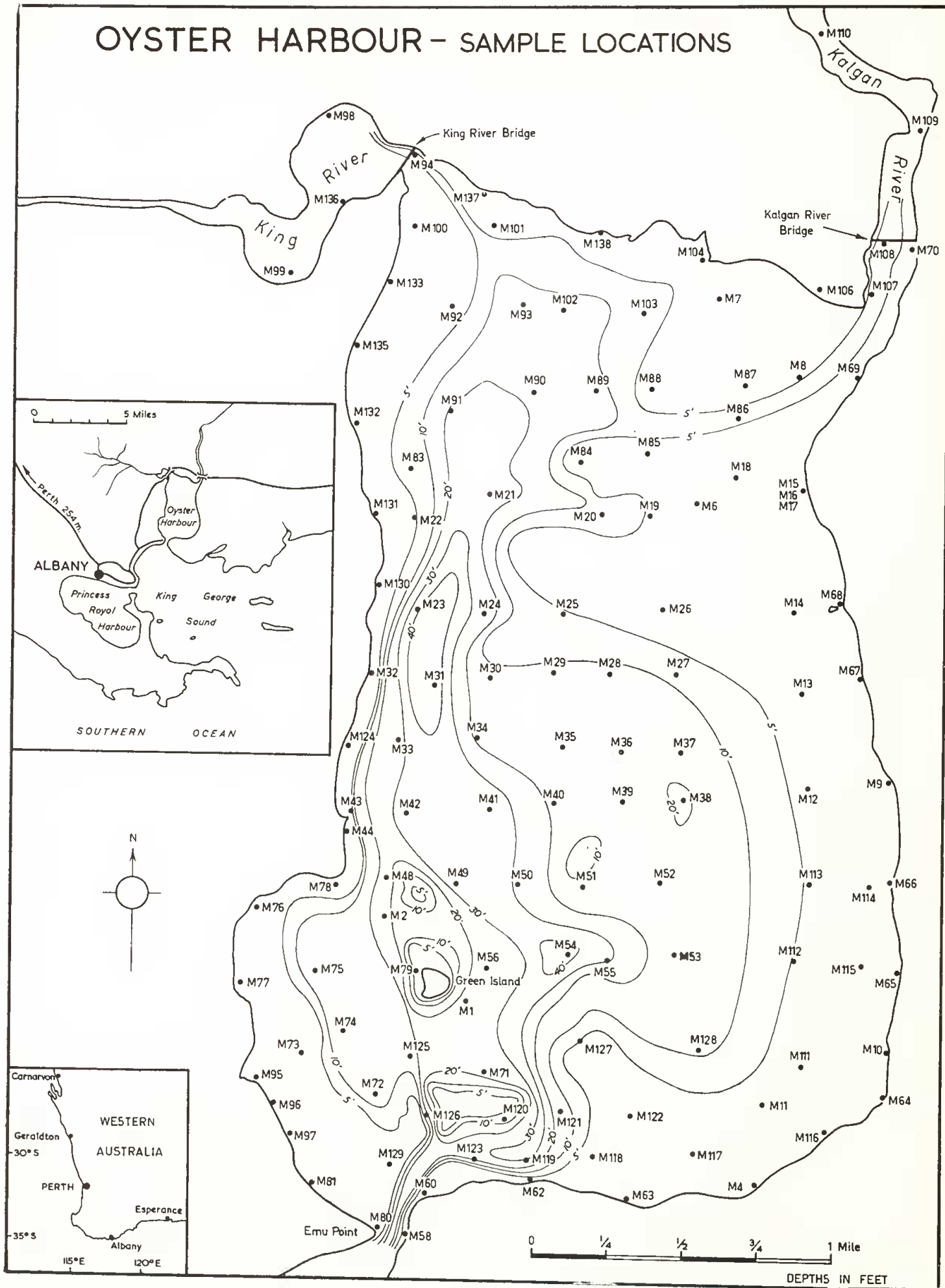


Fig. 1
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50 fathoms whereas at Oyster Harbour it occurs in a single shore sample. However, it is recorded from shallow water (5-10 fathoms) in the Kerimba Archipelago, off the eastern coast of Africa, between latitude 10° 40' S. and latitude 13° 00' S.

Miliammina fusca (Brady)

Quinqueloculina fusca Brady 1870, p. 286.
Miliolina fusca (Brady); Heron-Allen and Earland 1915, p. 576.

This small species is common in shallow water brackish environments. The siliceous test determines the transfer of this species to the genus *Miliammina*.

Miliammina sclerotica (Karrer)

Quinqueloculina sclerotica Karrer 1868, p. 152, Plate III, Fig. 5; Cushman 1929, p. 24, Plate I, Fig. 5 a-d.

The specimens from Oyster Harbour resemble Cushman's figures. This species also is transferred to *Miliammina* because of its siliceous test.

Miliammina sp.

Test small, siliceous, sub-circular in outline, rather compressed; coiling milioline, the later chambers broader than the earlier ones; aperture rounded with a small pointed tooth. One specimen.

Reophax scorpiurus Montfort

Reophax scorpiurus Montfort 1808, p. 331, text-fig. p. 330; Chapman and Parr 1935, p. 3; Chapman 1941, p. 191.

Distributed along the southern coast from south-east Australia to Oyster Harbour.

Nouria polymorphinoides Heron-Allen and Earland

Nouria polymorphinoides Heron-Allen and Earland 1914, p. 376, Plate XXXVII, Figs. 1-15; Logan 1959, p. 204, 246.

Several specimens were obtained from one sample. This species was first described from the Kerimba Archipelago. Logan records it from Shark Bay, on the west coast of Western Australia. It is characteristic of shallow waters in the sub-tropical Indian Ocean but the Oyster Harbour record shows that its distribution extends to temperate latitudes.

Ammobaculites agglutinans (d'Orbigny)

Spirolina agglutinans d'Orbigny 1846, p. 137, Plate VII, Figs. 10-12.

Ammobaculites agglutinans (d'Orbigny); Chapman 1941, p. 191; Logan 1959, p. 181, 232.

The species has been recorded from Bass Strait and Shark Bay. The Oyster Harbour occurrence is intermediate in this extensive distribution along the southern Australian coastline.

Haplophragmoides sp. aff. **grandiformis** Cushman

Haplophragmoides grandiformis Cushman 1910, p. 440, text-fig. 11; Chapman and Parr 1935, p. 3; Chapman 1941, p. 190.

This distinctive species selects heavy mineral and quartz sand grains for its test, binding them with a yellowish-brown cement. The specimens from Oyster Harbour, however, do not attain the dimension of Cushman's type (3mm diameter). Distribution of the species extends from south-east Australia to Oyster Harbour.

Textularia candeiana d'Orbigny

Textularia candeiana d'Orbigny 1839, p. 143, Plate I, Figs. 25-27; Chapman and Parr 1935, p. 3; Heron-Allen and Earland 1915, p. 627.

All Australian records of this species, as far the author is aware, are from the southern coast of Western Australia.

Textularia conica d'Orbigny

Textularia conica d'Orbigny 1839, p. 143, Plate I, Figs. 19-20; Chapman 1941, p. 191; Parr in Fairbridge, 1950, p. 70; Parr 1945, p. 194.

This species has a wide distribution in southern Australian coastal waters.

Trochammina inflata (Montagu)

Nautilus inflatus Montagu 1808, p. 81, Plate XVIII, Fig. 3.

Trochammina inflata (Montagu); Parr 1945, p. 194.

A distinctive shallow water species, tolerant of the brackish conditions in the mouths of creeks and estuaries, also known to occur off Barwon Heads, Victoria.

Gaudryina (Pseudogaudryina) hastata (Parr)

Gaudryina hastata Parr 1932b, p. 219, Plate XXII, Fig. 40 a, b; Chapman and Parr 1935, p. 4.

Gaudryina (Pseudogaudryina) hastata (Parr); Parr in Fairbridge, 1950, p. 70.

The species is known to occur from the coast of New South Wales westwards to Point Peron, near Perth, Western Australia.

Gaudryina triangularis Cushman

Gaudryina triangularis Cushman 1911, p. 65, text-fig. 104 a-c; Chapman and Parr 1935, p. 4; Chapman 1941, p. 193.

A large robust species with some variation in the arrangement of the later, inflated, uniserial chambers; distributed in southern Australian waters from Bass Strait to Oyster Harbour.

Gaudryina triangularis Cushman var. **angulata** Cushman

Gaudryina rugosa d'Orbigny; Heron-Allen and Earland 1915, p. 635.

Gaudryina triangularis Cushman var. *angulata* Cushman 1924, p. 22; Cushman 1932, p. 14, Plate III, Fig. 7 a, b.

The Oyster Harbour specimens follow precisely the descriptions quoted above and agree well with the published figures. This, as far as the author is aware, is the first Australian record for the species.

Clavulina difformis Brady

Clavulina angularis d'Orbigny var. *difformis* Brady 1884, p. 396, Plate XLVIII, Figs. 25-31.

Clavulina difformis Brady; Chapman and Parr 1935, p. 4.

This species differs from *Clavulina pacifica* Cushman in that it is polygonal or quadrangular in transverse section rather than triangular, and also in possessing a rougher test. It dominates over *C. pacifica* in Oyster Harbour and has also been recorded from the Great Australian Bight.

Clavulina pacifica Cushman

Clavulina pacifica Cushman 1924, p. 22 Plate VI, Figs. 7-11; Parr in Fairbridge, 1950, p. 70; Logan 1959, p. 183, 237.

This species is very rare in Oyster Harbour which may be a fringe location for it. It is recorded northwards along the west coast of Western Australia from Triggs Island, near Perth, from Geraldton and from Shark Bay. Only a few specimens are recorded from Triggs Island and Geraldton, but the species is frequent in Shark Bay.

Clavulina serventyi Chapman and Parr =

Pseudoclavulina serventyi (Chapman and Parr); Barker 1960, p. 98.

Clavulina serventyi Chapman and Parr 1935, p. 5, Plate I, Fig. 7 a, b; Chapman 1941, p. 192; Parr 1950, p. 284.

Several samples from Oyster Harbour contain many examples of this species which was originally described from the Great Australian Bight. Parr has also recorded it off Tasmania.

Cribrobulimina polystoma (Parker and Jones)

Valvulina polystoma Parker and Jones 1865, p. 437, 438, table X.

Cribrobulimina polystoma (Parker and Jones); Chapman and Parr 1935, p. 4; Parr in Fairbridge, 1950, p. 70.

A distinctive, robust species, its known distribution in Australian waters extends from the coast near Melbourne, Victoria, westwards to Oyster Harbour, then north to Perth and Geraldton in Western Australia.

Nubecularia lucifuga DeFrance

Nubecularia lucifuga DeFrance 1825, p. 210; Brady 1884, p. 134, Plate I, Figs. 9-16; Chapman and Parr 1935, p. 3; Parr 1945, p. 195.

Brady's text and figures emphasise the variability of this species which is widely distributed in southern Australian waters. The Oyster Harbour specimens are highly variable in their morphology and some acquire the calcareous encrustation which is a further characteristic of this species.

Parrina bradyi (Millett)

Nubecularia inflata Brady 1884, p. 135, Plate I, Figs. 5-8.

Nubecularia bradyi Millett 1898, p. 261, Plate V, Fig. 6 a, b.

Parrina bradyi (Millett); Cushman 1932, p. 74, Plate XVII, Figs. 1-4; Chapman and Parr 1935, p. 3.

Consisting of an irregular series of inflated chambers, with a single aperture, or with numerous apertures, usually irregularly placed, this species is characteristic of shallow water environments in the Indo-Pacific.

Hauerina sp.

Only one specimen. The relationships of this species are to *H. diversa* Cushman and to *H. intermedia* Howchin. It resembles the former in size, shape, slight curvature of sutures, and ornamentation, and the latter in its aperture, which is non-cribrate and in its inflated chambers.

Spirothamidium concentricum (Terquem and Berthelin)

Spiroloculina concentrica Terquem and Berthelin 1875, p. 80, Plate VII, Figs. 1-4.

Spirothamidium concentricum (Terquem and Berthelin); Ellis and Messina 1940 et seq, volume 2.

Three specimens, one representing a costate variety of this species.

Vertebralina striata d'Orbigny

Vertebralina striata d'Orbigny 1826, p. 283; Brady 1884, p. 187, Plate XII, Figs. 14-16; Parr in Fairbridge, 1950, p. 71; Logan 1959, p. 203, 270.

This well-known species is widely distributed in the shallow water margins of warm latitude seas. Along the coast of Western Australia it is common in Oyster Harbour, and has been recorded from Garden Island, near Perth, from Geraldton, and throughout Shark Bay.

Vertebralina sp.

There are several examples. The species is similar to *V. striata* d'Orbigny in its initial cornuspirine coiling, ornamentation and aperture, but typically contains more chambers, is narrower and has cusped margins. *V. striata* is known to be highly variable, however, so that this species may well represent one extreme of its development.

Spiroloculina

The classification of Loeblich and Tappan (1961) differs markedly from other, more familiar, classifications (Cushman 1950, Glaessner 1945) in that the Spiroloculininae are included as a sub-family of the family Nubeculariidae rather than in the family Miliolidae. The distinction rests on whether *Spiroloculina*, in its early stages, has a quinqueloculine or cornuspirine coiling. Loeblich and Tappan are followed here.

Spiroloculina angulata Cushman

Spiroloculina grata Terquem var. *angulata* Cushman 1917, p. 36, Plate VII, Fig. 5 a, b.

Spiroloculina angulata Cushman; Asano 1951, part 6, p. 12, Figs. 85, 86.

This species differs from *Spiroloculina antillarum* d'Orbigny in that it possesses a keeled periphery. It possibly has been recorded as *S. antillarum* by previous workers on Australian faunas.

Spiroloculina antillarum d'Orbigny

Spiroloculina antillarum d'Orbigny 1839, p. 166, Plate IX, Figs. 3, 4; Parr 1932a, p. 9; Parr 1945, p. 197; Parr in Fairbridge, 1950, p. 70; Logan 1959, p. 195, 263.

Recorded in southern Australian coastal waters from Victoria westwards to Oyster Harbour, then north to Geraldton and on to Shark Bay.

Spiroloculina canaliculata d'Orbigny = *Spiroloculina communis* Cushman and Todd; Barker 1960, p. 20.

Spiroloculina canaliculata d'Orbigny 1846, p. 269, Plate XVI, Figs. 10-12; Chapman and Parr 1935, p. 3; Chapman 1941, p. 187.

This species was recorded by Brady (1884, p. 151, Plate X, Figs. 3, 4) as *Spiroloculina impressa* Terquem from shallow water in the tropical Pacific. The Australian records cited, however, are from temperate latitudes.

Spiroloculina hadai Thalmann

Spiroloculina hadai Thalmann 1933, p. 354, Asano 1951, part 6, p. 14, Figs. 97, 98.

Many specimens were identified in Oyster Harbour, apparently the first record of this species in southern Australian waters.

Spiroloculina milletti Wiesner = *Massilina milletti* (Wiesner); Barker 1960, p. 18.

Spiroloculina nitida d'Orbigny 1826, p. 298; Brady 1884, p. 149, Plate IX, Figs. 9, 10.

Spiroloculina milletti Wiesner; Chapman and Parr 1935, p. 3; Parr in Fairbridge, 1950, p. 70; Parr 1945, p. 197.

Common in the Indo-Pacific. The Australian records cited give a distribution from Barwon Heads, Victoria to Geraldton in Western Australia. It is possible that Logan (1959, p. 264) has called this species *Spiroloculina antillarum* d'Orbigny var. *aequa* Cushman, if so its distribution in Western Australia extends nearly to Carnarvon.

Planispirinoides bucculentus (Brady)

Miliolina bucculenta Brady 1884, p. 170, Plate CXIV, Fig. 3 a, b.

Planispirina bucculenta (Brady); Chapman and Parr 1935, p. 3; Chapman 1941, p. 186; Parr 1945, p. 195.

Planispirinoides bucculentus (Brady); Parr 1950, p. 287, text-figs. 1-5, Plate VI, Figs. 1-6.

The sections figured by Parr (1950) make it clear that this is a nubeculariid, although its external characters show affinities to the miliolids. Common in Oyster Harbour.

Pyrgo fornasinii Chapman and Parr

Biloculina ringens Brady 1884, p. 142, Plate II, Fig. 7.
Pyrgo fornasinii Chapman and Parr 1935, p. 5; Chapman 1941, p. 189.

A widely distributed species, but very rare in Oyster Harbour.

Triloculina cf. flavescens d'Orbigny

Triloculina flavescens d'Orbigny 1826, p. 300; Fornasini 1905, p. 60, Plate I, Figs. 8, 8a, b.

Although this species has been recorded only rarely, and no Indo-Pacific records are known to the author, the Oyster Harbour specimen is so similar to the type figures that it is compared with d'Orbigny's species.

Triloculina laevigata d'Orbigny

Triloculina laevigata d'Orbigny 1826, p. 134; Asano 1951, part 6, p. 15, Figs. 103-105.

Some of the Oyster Harbour specimens included with this species are more round than the typical forms.

Triloculina rotunda d'Orbigny

Triloculina rotunda d'Orbigny 1825, p. 299, Heron-Allen and Earland 1915, p. 568, Plate XLII, Figs. 27-30; Logan 1959, p. 200, 268, Plate III, Fig. 7.

Rare in Oyster Harbour. Logan has recorded the species from Shark Bay.

Triloculina striatotrigonula (Parker and Jones)

Miliola (Triloculina) striatotrigonula Parker and Jones 1865, p. 438.

Triloculina striatotrigonula (Parker and Jones); Parr 1941, p. 305; Parr 1945, p. 198; Parr in Fairbridge, 1950, p. 70.

This species, which has also been recorded from Australian waters as *Triloculina insignis* (Brady), is common off the south coast of Australia and is known to occur as far north as Geraldton on the west coast of Western Australia.

Triloculina tricarinata d'Orbigny

Triloculina tricarinata d'Orbigny 1826, p. 299; Chapman and Parr 1935, p. 3; Chapman 1941, p. 188; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 294; Logan 1959, p. 200, 269.

Another widely distributed species, recorded in southern Australian waters from east of Tasmania to Shark Bay. The Oyster Harbour specimens are not as sharply-angled as the type figure.

Triloculina trigonula (Lamarck)

Miliola trigonula Lamarck 1804, p. 351, no. 3.
Triloculina trigonula (Lamarck); Chapman and Parr 1935, p. 3; Chapman 1941, p. 188; Parr 1945, p. 197; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 295; Logan 1959, p. 201, 269.

Common in southern Australian waters from Bass Strait to Shark Bay.

Triloculina sp. Cushman

Triloculina sp. Cushman 1932, p. 61, Plate XIII, Fig. 7 a-c.

This species, described by Cushman from the tropical Pacific, is probably close to *Triloculina laevigata* d'Orbigny. Cushman states that it

seems to be on the borderline between *Triloculina* and *Quinqueloculina*. The few Oyster Harbour examples follow his figures.

Miliolinella circularis (Bornemann)

Triloculina circularis Bornemann 1885, p. 349, Plate XIX, Fig. 4; Chapman and Parr 1935, p. 3; Chapman 1941, p. 188; Parr 1945, p. 198; Logan 1959, p. 198, 267.

Miliolinella circularis (Bornemann); Asano 1951, part 6, p. 9, Figs. 65-67.

Common in southern Australian waters. The species described as *Miliolinella vigilax* Vella, from shallow waters in Cook Strait, New Zealand (Vella 1957, p. 21, Plate VII, Figs. 124-126), which closely resembles *M. circularis*, must be considered at least an ecotype of Bornemann's species.

Miliolinella labiosa (d'Orbigny)

Triloculina labiosa d'Orbigny 1839, p. 178, Plate X, Figs. 12-14; Parr 1932b, p. 220; Parr 1945, p. 198.

Placed in *Miliolinella* on the basis of its miliolinellid aperture. Parr consistently avoids the generic name *Miliolinella* and records this species as *Triloculina labiosa*, noting that it is widely distributed in the Indo-Pacific. Common in Oyster Harbour.

Miliolinella oblonga (Montagu)

Vermiculium oblongum Montagu 1803, p. 522, Plate XIV, Fig. 9.

Triloculina oblonga (Montagu); Parr 1932a, p. 10, Plate I, Fig. 15 a-c; Parr 1945, p. 198; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 294; Logan 1959, p. 199, 268.

Miliolinella oblonga (Montagu); Chapman 1941, p. 183.

Frequently recorded in Oyster Harbour this species occurs from Bass Strait to Shark Bay, in southern Australian waters.

Miliolinella sublineata (Brady)

Miliolina circularis (Bornemann) var. *sublineata* Brady 1884, p. 169, Plate IV, Fig. 7.

Triloculina circularis Bornemann var. *sublineata* (Brady); Parr 1945, p. 198; Logan 1959, p. 199, 268.

Miliolinella sublineata (Brady); Asano 1951, part 6, p. 10, Figs. 70-72.

The Oyster Harbour specimens resemble those described by Parr. Distribution of the species along the southern Australian coast extends from Barwon Heads, Victoria, to Shark Bay, Western Australia.

Sigmoilina australis (Parr) = *Miliolinella* (?)
australis (Parr); Barker 1960, p. 10.

Quinqueloculina australis Parr 1932a, p. 7, Plate I, Figs. 8 a-c; Chapman and Parr 1935, p. 3; Chapman 1941, p. 186; Parr in Fairbridge, 1950, p. 70.

Sigmoilina australis (Parr); Parr 1945, p. 197; Parr 1950, p. 292.

A common Australian species. Logan (1959, p. 190) has placed it in *Miliolinella*, overlooking the fact that Vella has included *Sigmoilina* in the sub-family Miliolinellinae (Vella 1957, p. 20). The Oyster Harbour examples are small but typical.

Quinqueloculina bicornis (Walker and Jacob)

Serpula bicornis Walker and Jacob in Kanmacher, 1798, p. 633, Plate XIV, Fig. 2.

Quinqueloculina bicornis (Walker and Jacob); Heron-Allen and Earland 1915, p. 580.

Very rare in Oyster Harbour.

Quinqueloculina bosciana d'Orbigny

Quinqueloculina bosciana d'Orbigny 1839, p. 191, Plate XI, Figs. 22-24; Heron-Allen and Earland 1915, p. 566; Parr in Fairbridge, 1950, p. 70.

Frequently recorded in Oyster Harbour, this species shows some variation in the length and width of its test and in its ornamentation. It has also been recorded from Triggs Island, near Perth.

Quinqueloculina bradyana Cushman

Quinqueloculina bradyana Cushman 1917, p. 52, Plate XVIII, Fig. 2; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 290, Plate VI, Fig. 11; Logan 1959, p. 185, 252, Plate II, Fig. 5.

Distributed in southern Australian waters from Bass Strait to Shark Bay. Very rare in Oyster Harbour.

Quinqueloculina costata d'Orbigny

Quinqueloculina costata d'Orbigny 1826, p. 301; Parr 1932a, p. 8, Plate I, Fig. 9; Parr 1945, p. 197; Parr in Fairbridge, 1950, p. 70.

The distribution of this small species in southern Australian waters extends from Melbourne, Victoria, to Geraldton, Western Australia.

Quinqueloculina dilatata d'Orbigny

Quinqueloculina dilatata d'Orbigny 1839, p. 192, Plate XI, Figs. 28-30; Parr 1945, p. 196.

Rare in Oyster Harbour, this distinctive species also occurs off Barwon Heads, Victoria.

Quinqueloculina granulocostata Germeraad

Quinqueloculina granulocostata Germeraad 1946, p. 63; Logan 1959, p. 187, 252, Plate II, Fig. 6.

Examples of this large Indo-Pacific species, also known to occur in Shark Bay, were found in several samples from Oyster Harbour.

Quinqueloculina cf. inaequalis d'Orbigny

Quinqueloculina inaequalis d'Orbigny 1839, p. 142, Plate III, Figs. 28-30.

Two specimens. These tend to *Q. inaequalis* rather than *Q. sigmoilinooides* Vella in respect of their apertures and the concavo-convexity of their chambers. Vella's species (Vella 1957, p. 24, Plate VI, Figs. 115-117) should be renamed as *Q. sigmoilinooides* is already occupied (Gianotti 1953, p. 43, Plate IV, Fig. 1 a-d).

Quinqueloculina lamarckiana d'Orbigny

Quinqueloculina lamarckiana d'Orbigny 1839, p. 189, Plate XI, Figs. 14, 15; Chapman and Parr 1935, p. 3; Parr 1945, p. 196; Chapman 1941, p. 187; Parr in Fairbridge, 1950, p. 70.

This common species has been recorded in southern Australian waters from Bass Strait to Geraldton.

Quinqueloculina poeyana d'Orbigny

Quinqueloculina poeyana d'Orbigny 1839, p. 191, Plate XI, Figs. 25-27; Chapman and Parr 1935, p. 3; Parr 1950, p. 290.

Differentiated from *Q. costata* d'Orbigny by its larger test, dull finish, stronger ribbing and more prominent tooth, this species is also known to occur in the Great Australian Bight and off Albany.

Quinqueloculina polygona d'Orbigny

Quinqueloculina polygona d'Orbigny 1839, p. 193, Plate XII, Figs. 21-23; Chapman and Parr 1935, p. 3.

A few rather worn examples were identified. Chapman and Parr record the species from the western Great Australian Bight.

Quinqueloculina seminula (Linné)

Serpula seminulum Linné 1758, p. 1264, no. 791 (12th edition).

Quinqueloculina seminula (Linné); Chapman 1941, p. 187; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 289; Logan 1959, p. 188, 256.

This very common species has a complex taxonomic history, and has still to be described adequately. It has been recorded in southern Australian waters from Bass Strait to Perth. Logan (1959), describing the Shark Bay fauna, places a strongly-ribbed population in *Q. seminula*, but his material may well be *Q. seminula* var. *jugosa* Cushman. The Oyster Harbour specimens are all of the typical smooth-shelled variety.

Quinqueloculina seminula (Linné) var. *longa* Gherke

Quinqueloculina seminula (Linné) var. *longa* Gherke 1938, p. 306, Plate II, Figs. 5-8; Kruit 1955, p. 467, Plate I, Fig. 11.

Gherke's material was fossil but the species is known to occur to-day, for example in the Rhone delta (Kruit 1955), an environment somewhat similar to Oyster Harbour in respect of salinity, temperature and depth.

Quinqueloculina stelligera Schlumberger

Quinqueloculina stelligera Schlumberger 1893, p. 68, text-fig. 17, Plate II, Figs. 58, 59; Cushman 1929, p. 28, Plate III, Figs. 3, 4.

The few Oyster Harbour examples of this species are rather worn.

Quinqueloculina striata d'Orbigny

Quinqueloculina striata d'Orbigny 1826, p. 301; Heron-Allen and Earland 1915, p. 579, Plate XLIV, Figs. 13-17.

This is the first record of the species from Western Australian waters.

Quinqueloculina subarenaria Cushman

Quinqueloculina subarenaria Cushman 1917, p. 44, Plate X, Figs. 1, 2; Asano 1951, part 6, p. 7, Figs. 49-51.

The holotype was described from shallow water off Singapore. Asano, however, records this species from cooler waters in the Japan Sea. It is frequent in some samples in Oyster Harbour; the first record for the species in Western Australian waters.

Quinqueloculina suborbicularis d'Orbigny

Quinqueloculina suborbicularis d'Orbigny 1826, p. 302; Vella 1957, p. 23, Plate VI, Figs. 102-104.

Vella (p. 23) states with justification that specific names, such as *Q. seminula* and *Q. vulgaris* d'Orbigny, have been applied to a wide variety of shells, and should be restricted to forms approaching the original figures and descriptions. The author follows Vella in reviving *Q. suborbicularis* for forms that have probably been recorded as *Q. vulgaris* by earlier workers on southern Australian faunas. The species is common in Oyster Harbour.

Quinqueloculina subpolygona Parr

Quinqueloculina subpolygona Parr 1945, p. 196 Plate XII, Fig. 2; Parr in Fairbridge, 1950, p. 70; Parr 1950, p. 290; Logan 1959, p. 189, 255, Plate II, Fig. 11.

Typical examples of this southern Australian species were identified in several samples.

Quinqueloculina sulcata d'Orbigny

Quinqueloculina sulcata d'Orbigny 1826, p. 301; Logan 1959, p. 189, 256, Plate II, Fig. 9.

Frequent in Oyster Harbour, this species also occurs in Shark Bay.

Quinqueloculina sp. 1

Only two specimens preclude the formal definition of a new species.

Test small, sub-rectangular, rather compressed; wall smooth, porcellanous; chambers quinqueloculine; sutures depressed, somewhat indistinct; aperture a long, narrow slit, hooked at one end, with a slight lip; tooth absent.

Quinqueloculina sp. 2

One example. Test small, elongate, with a slightly sinuous periphery, compressed; wall smooth, porcellanous; chambers quinqueloculine; sutures indistinct, oblique, somewhat depressed; neck prominent; aperture narrow, elliptical; tooth absent.

Schlumbergerina alveoliniformis (Brady)

Miliolina alveoliniformis Brady 1879, p. 268; Brady 1884, p. 181, Plate VIII, Figs. 15-20.

Schlumbergerina alveoliniformis (Brady); Thalmann 1932, p. 297.

Two juveniles are placed in this species which usually inhabits shallow waters of tropical latitudes.

Cribrolinoides curta (Cushman)

Quinqueloculina disparilis d'Orbigny var. *curta* Cushman 1917, p. 49, Plate XIV, Fig. 2; Logan 1959, p. 186, 252.

Cribrolinoides curta (Cushman); Asano 1951, part 6, p. 9, Figs. 63, 64.

Also recorded from Shark Bay, this small, biscuit-coloured species is very rare in Oyster Harbour.

Ptychomiliola separans (Brady)

Miliolina separans Brady 1881, p. 45; Chapman and Parr 1935, p. 3, 4, Plate I, Fig. 3; Chapman 1941, p. 187; Parr 1950, p. 291.

Apparently restricted to Australian waters, this unusual species has been recorded off the east and south coasts of Australia from Torres Strait to the Bight. The present record extends its known distribution further westwards.

Pseudomassilina australis (Cushman)

Massilina australis Cushman 1932, p. 32, Plate VIII, Fig. 2 a, b.

Pseudomassilina australis (Cushman); Lacroix, 1938, p. 3.

The type locality is off Cook Island in the Pacific where this species occurs in shallow water. It is very rare in Oyster Harbour.

Siphonaperta ammophila (Parr)

Quinqueloculina ammophila Parr 1932a, p. 8, text-fig. 1E, Plate I, Fig. 10 a, b; Chapman and Parr 1935, p. 3.

Massilina ammophila (Parr); Parr 1950, p. 292, Plate VI, Fig. 16.

Siphonaperta ammophila (Parr); Vella 1957, p. 19.

The type locality for this is Westernport Bay, south-east of Melbourne, Victoria, and it has also been recorded off Tasmania and in the Great Australian Bight. The present record extends its known distribution westwards. The Oyster Harbour examples, however, are only rarely as compressed as Parr's figured specimens and may be related more closely to *Quinqueloculina agglutinans* d'Orbigny.

Massilina annectens Schlumberger

Massilina annectens Schlumberger 1893, p. 78, text-figs. 35-37, Plate III, Figs. 77-79.

One specimen, closely resembling Schlumberger's Fig. 78.

Massilina cf. **planispiroidea** Martinotti

Massilina planispiroidea Martinotti 1921, p. 314, text-figs. 129, 130, Plate IV, Figs. 1-3.

One example, which is compared with Martinotti's species from the shores of Tripoli.

Massilina secans (d'Orbigny)

Quinqueloculina secans d'Orbigny 1826, p. 303.

Massilina secans (d'Orbigny); Logan 1959, p. 191, 245.

Very rare in Oyster Harbour. Recorded by Logan from Shark Bay as a stenohaline marine species.

Massilina secans (d'Orbigny) var. **tenuistriata** Earland

Miliolina (*Massilina*) *secans* (d'Orbigny) var. *tenuistriata* Earland 1905, p. 198, Plate XI, Fig. 5.

Massilina secans (d'Orbigny) var. *tenuistriata* Earland; Heron-Allen and Earland 1915, p. 582, Plate XLIV, Figs. 28-31.

Several examples from Oyster Harbour, the first record of this variety in Western Australian waters.

Peneroplis pertusus (Forskål)

Nautilus pertusus Forskål 1775, p. 125.

Peneroplis pertusus (Forskål) Parr in Fairbridge, 1950, p. 71; Logan 1959, p. 210.

This species, which has also been recorded from Shark Bay and Geraldton Harbour, is common in Oyster Harbour. It is usually smaller than *Peneroplis planatus* (Fichtel and Moll), and is further distinguished from that species by its fatter test and different aperture.

Peneroplis planatus (Fichtel and Moll)

Nautilus planatus Fichtel and Moll 1798, p. 91 (in an 1803 reprint).

Peneroplis planatus (Fichtel and Moll); Chapman and Parr 1935, p. 3; Parr 1945, p. 199; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 299; Logan 1959, p. 211, 246, Plate IV, Figs. 6, 7.

This widely distributed species is common in southern Australian waters from Victoria to Shark Bay. The Oyster Harbour specimens include forms tending towards *Spirolina arietina* (Batsch.)

Peneroplis sp.

Test large, initially close-coiled and thickened, becoming expanded towards the apertural end; ornamentation of numerous striae; aperture a row of pores along the median line of the apertural face. This species appears to be intermediate between *Peneroplis proteus* d'Orbigny, and *P. planatus*, differing from the former in its ornamentation, and from the latter in the general shape of its test and in the initial thickening. Several specimens were taken in Oyster Harbour.

Dendritina antillarum d'Orbigny

Dendritina antillarum d'Orbigny 1826, p. 285; Cushman 1930, part 7, p. 42, Plate XIV, Figs. 2, 3.

A few specimens with the characteristic dendritine aperture were identified as belonging to this species.

Spirolina cylindracea (Lamarck)

Spirolinites cylindracea Lamarck 1804, p. 245.

Spirolina cylindracea (Lamarck); Chapman and Parr 1935, p. 2.

This slender, cylindrical species has previously been recorded in Western Australian waters only from the western Great Australian Bight. It is rare in Oyster Harbour.

Marginopora vertebralis Quoy and Gaimard

Marginopora vertebralis Quoy and Gaimard in Blainville, 1830, p. 377; Chapman and Parr 1935, p. 3; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 299; Logan 1959, p. 215, 244.

Frequently recorded along the western coastline of Western Australia but rare along the southern coast of this State. Two broken specimens were found near the southern entrance to Oyster Harbour.

Guttulina (Sigmoidina) pacifica (Cushman and Ozawa)

Sigmoidella (Sigmoidina) pacifica Cushman and Ozawa 1928, p. 19, Plate II, Fig. 13.

Guttulina (Sigmoidina) pacifica (Cushman and Ozawa); Asano 1951, part 8, p. 5, Figs. 24-26.

Only one example of this common Indo-Pacific species.

Guttulina kishinouyi Cushman and Ozawa

Guttulina kishinouyi Cushman and Ozawa 1930, p. 40, Plate VIII, Figs. 5, 6; Asano 1951, part 8, p. 2, Figs. 6, 7.

Not previously recorded from Western Australian waters, and very rare in Oyster Harbour.

Guttulina cf. lactea (Walker and Jacob)

Serpula lactea Walker and Jacob in Kanmacher, 1798, p. 634, Plate XIV, Fig. 4.

Guttulina lactea (Walker and Jacob); Parr and Collins 1937, p. 195, Plate XII, Fig. 8; Chapman 1941, p. 164; Parr 1945, p. 204.

The single specimen is hesitantly compared with this species which it appears to resemble most nearly, and which has been previously recorded from south-eastern Australia and Barwon Heads, Victoria.

Guttulina yabei Cushman and Ozawa

Guttulina yabei Cushman and Ozawa 1929, p. 68, Plate XIII, Fig. 2, Plate XIV, Fig. 6 a, b; Parr and Collins 1937, p. 192, Plate XIII, Fig. 4 a-c; Chapman 1941, p. 164; Parr 1945, p. 204.

Recorded in south-eastern Australian waters from Sydney to Barwon Heads, Victoria. The slender form figured by Parr and Collins was present in three samples from Oyster Harbour where it occurs more frequently than any other polymorphinid.

Guttulina yamazakii Cushman and Ozawa

Guttulina yamazakii Cushman and Ozawa 1930, p. 40, Plate VIII, Figs. 3, 4; Parr and Collins 1937, p. 196, Plate XIII, Fig. 5 a-c; Logan 1959, p. 205, 244, Plate III, Fig. 8.

One typical example of this species was identified in Oyster Harbour. Logan has microradiographed a specimen from Shark Bay.

Sigmoidella elegantissima (Parker and Jones)

Polymorphina elegantissima Parker and Jones 1864, p. 438.

Sigmoidella elegantissima (Parker and Jones); Chapman and Parr 1935, p. 2; Parr and Collins 1937, p. 206, Plate XIV, Fig. 9; Parr 1945, p. 205; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 335.

Recorded in southern Australian waters from Port Jackson, N.S.W., to Geraldton, W.A. Very rare in Oyster Harbour.

Oolina globosa (Montagu)

Vermiculum globosum Montagu 1803, p. 523.

Lagena globosa (Montagu); Brady 1884, p. 452, text-fig. 11 a-m, Plate LVI, Figs. 1-3; Chapman and Parr 1935, p. 2.

Entosolenia globosa (Montagu); Parr 1945, p. 204.

Oolina globosa (Montagu); Parr 1950, p. 302.

Only one example of this small species.

Bolivinella folium (Parker and Jones)

Textularia agglutinans d'Orbigny var. *folium* Parker and Jones 1865, p. 370, 420, Plate XVIII, Fig. 19.

Bolivinella folium (Parker and Jones); Chapman and Parr 1935, p. 2; Chapman 1941, p. 169; Parr 1945, p. 205; Parr in Fairbridge, 1950, p. 71; Logan 1959, p. 216, 235.

The type locality for this species is a shore sand near Melbourne, Victoria. It is common in Australian waters as the records cited indicate.

Bolivina earlandi Parr

Bolivina punctata d'Orbigny 1839, p. 63, Plate VIII, Figs. 10-12; Chapman 1941, p. 167.

Bolivina earlandi Parr; Parr 1950, p. 339, Plate XII, Fig. 16 a, b.

Widely distributed in Australian waters. The Oyster Harbour specimens follow Parr's species in possessing rounded, rather than sharp-edged, margins.

Reussella ensiformis (Chapman)

Verneuulina ensiformis Chapman 1910, p. 271, Plate II, Fig. 1 a, b.

Reussia ensiformis (Chapman); Chapman and Parr 1935, p. 2, 4, Plate I, Fig. 1.

Several examples of this species were found thus reinforcing Chapman and Parr's record of one specimen from the Great Australian Bight. This is important, as prior to Chapman and Parr's paper all records of the species were from the Oligocene and Miocene of Victoria. The generic name *Reussella* is used after Galloway (1933, fide Ellis and Messina 1940 *et seq.*).

Siphogenerina raphana (Parker and Jones)

Uvigerina (Sagrina) raphanus Parker and Jones 1865, p. 364, Plate XVIII, Figs. 16 a, b, 17.

Siphogenerina raphanus (Parker and Jones); Chapman and Parr 1935, p. 2; Parr 1945, p. 207; Parr in Fairbridge, 1950, p. 71; Logan 1959, p. 220, 260.

Widely distributed in southern Australian waters from Barwon Heads to Shark Bay.

Discopulvinulina australis (Parr) = *Discorbis australis* Parr; Barker 1960, p. 180.

Discorbis australis Parr 1932b, p. 227, Plate XXII, Fig. 31 a-c; Chapman and Parr 1935, p. 3; Chapman 1941, p. 171; Parr 1945, p. 209; Parr in Fairbridge, 1950, p. 71; Logan 1959, p. 221, 238.

Discopulvinulina australis (Parr); Asano 1951, part 14, p. 3, Figs. 20-22.

Distributed widely in southern Australian waters from Bass Strait to Shark Bay. Several small specimens were recorded at Oyster Harbour.

Discopulvinulina bradyi (Cushman) = *Rosalina bradyi* (Cushman); Barker 1960, p. 178.

Discorbis globularis d'Orbigny var. *bradyi* Cushman 1915, p. 12, Plate VIII, Fig. 1.

Discopulvinulina bradyi (Cushman); Asano 1951, part 14, p. 4, Figs. 25, 26.

One example of this widely distributed species common in the shallow waters of sub-tropical and temperate seas.

Discorbis cf. advena Cushman = *Conorboides cf. advena* (Cushman); Barker 1960, p. 180.

Discorbina rosacea (d'Orbigny); Brady 1884, in part, p. 644, Plate LXXXVII, Fig. 1.

Discorbis advena Cushman 1922, p. 40.

Cushman established this species from one of Brady's specimens figured as *Discorbina rosacea*. Brady states that *D. rosacea* is common in almost every sea, but Cushman's separated species is usually recorded from warm shallow waters in the western Atlantic. The Oyster Harbour example, though small, agrees well with Brady's figure and Cushman's description.

Discorbis australensis Heron-Allen and Earland = *Pileolina (?) australensis* (Heron-Allen and Earland); Barker 1960, p. 184.

Discorbina pileolus Brady 1884, p. 649, Plate LXXXIX, Figs. 2-4.

Discorbis australensis Heron-Allen and Earland 1932, p. 416; Parr 1945, p. 209.

Several examples including a twinned specimen. Parr, in recording the species from Barwon Heads, says it is common on the east coast of Australia.

Discorbis dimidiatus (Jones and Parker) = *Discorbis* sp. nov.; Barker 1960, p. 180.

Discorbina dimidiata Jones and Parker in Carpenter, 1862, p. 201, text-fig. 32B.

Discorbis dimidiatus (Jones and Parker); Chapman and Parr 1935, p. 3; Chapman 1941, p. 172; Parr 1945, p. 208; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 353.

The commonest species of *Discorbis* in southern Australian waters, known to occur from below Sydney westwards to Oyster Harbour and then northwards as far as North-West Cape. Among the many examples from Oyster Harbour were several large ones, thus supporting Parr's opinion that the largest specimens are usually found in temperate coastal waters.

Discorbis dimidiatus (Jones and Parker) var. **acervulinoides** Parr

Discorbis vesicularis (Lamarck) var. *acervulinoides* Parr 1932b, p. 229, Plate XXI, Fig. 30 a-c.

Discorbis dimidiatus (Jones and Parker) var. *acervulinoides* Parr; Chapman and Parr 1935, p. 3; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 353.

Distinguished by its conical test this variety was described from the coast of South Australia. It is known to occur in Western Australian waters from the Bight to as far north as Geraldton.

Discorbis mira Cushman = *Discorbina* (?) *mira* (Cushman); Barker 1960, p. 180.

Discorbis mira Cushman 1922, p. 39, Plate VI, Figs. 10-11; Chapman and Parr 1935, p. 3; Parr in Fairbridge, 1950, p. 71.

Recorded in Western Australian waters from the Bight to near Perth.

Discorbis opercularis (d'Orbigny) = *Pileolina* (?) *opercularis* (d'Orbigny); Barker 1960, p. 184.

Rosalina opercularis d'Orbigny 1839, p. 93, Plate III, Figs. 24, 25, Plate IV, Fig. 1.

Discorbis opercularis (d'Orbigny); Chapman and Parr 1935, p. 3; Chapman 1941, p. 172; Parr 1945, p. 209; Parr 1950, p. 355.

This distinctive species though never common is widely distributed in Australian waters although it has yet to be recorded from the west coast of Western Australia.

Discorbis patelliformis (Brady) = *Pileolina* (?) *patelliformis* (Brady); Barker 1960, p. 182.

Discorbina patelliformis Brady 1884, p. 647, Plate LXXXVIII, Fig. 3 a-c, Plate LXXXIX, Fig. 1 a-c.

Discorbis patelliformis (Brady); Chapman and Parr 1935, p. 3; Parr 1945, p. 209; Logan 1959, p. 222, 239, Plate V, Fig. 9.

Brady describes this as a shallow water Indo-Pacific species. It is well-known from the southern coast of Australia. The Oyster Harbour specimens are all small.

Eponides praecinctus (Karrer) = *Cibicides* *praecinctus* (Karrer); Barker, 1960, p. 196.

Rotalia praecincta Karrer 1868, p. 189, Plate V, Fig. 7.

Truncatulina praecincta (Karrer); Brady 1884, p. 667, Plate XCV, Figs. 1-3.

Eponides praecinctus (Karrer); Asano 1951, part 14, p. 11, Figs. 80-82.

Common on the Pacific coast of Japan and in the tropical southern Pacific. Brady also records it from the Red Sea. It is rare in Oyster Harbour.

Eponides repandus (Fichtel and Moll)

Nautilus repandus Fichtel and Moll 1798, p. 35, Plate III, Figs. a-d, in an 1803 reprint.

Eponides repandus (Fichtel and Moll); Chapman and Parr 1935, p. 3; Chapman 1941, p. 173; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 360.

Common off the southern coast of Australia from Bass Strait to Albany. Barker (1960, p. 214) comments on the taxonomy of this species.

Discorbinella biconcava (Jones and Parker)

Discorbina biconcava Jones and Parker in Carpenter, 1862, p. 201, text-fig. 32G.

Planulina biconcava (Jones and Parker); Chapman and Parr 1935, p. 3; Chapman 1941, p. 176.

Discorbinella biconcava (Jones and Parker); Parr 1945, p. 211.

The type locality for this species is near Melbourne, Victoria. It is known to occur also in the Gulf of Carpentaria, Torres Strait, Port Jackson, Bass Strait, off Cape Wiles and in the Bight. There are two small specimens from Oyster Harbour.

Planorbulina acervalis Brady

Planorbulina acervalis Brady 1884, p. 657, Plate XCII, Fig. 4; Parr in Fairbridge, 1950, p. 72; Logan 1959, p. 231, 247.

Very rare in Oyster Harbour, this species has also been recorded from Perth, Geraldton and Shark Bay in Western Australian waters. It is differentiated from *Planorbulina mediterraneanensis* d'Orbigny by its numerous acervuline segments.

Planorbulina rubra d'Orbigny

Planorbulina rubra d'Orbigny 1826, p. 280; Parr 1932b, p. 232, Plate XXII, Fig. 51 a-c; Parr in Fairbridge, 1950, p. 72; Parr 1950, p. 368.

A few examples of this species, recorded by Parr from shallow water off the coasts of Victoria and South Australia, and off Albany, were found in Oyster Harbour. All possess the characteristic reddish tinge. The type locality is a shore sand from Fremantle, Western Australia, and the species is also known from Geraldton Harbour.

Planorbulinella larvata (Parker and Jones)

Planorbulina larvata Parker and Jones 1865, p. 379, 380, Plate XIX, Fig. 3 a, b; Heron-Allen and Earland 1915, p. 706.

Planorbulinella larvata (Parker and Jones); Thalmann 1932, p. 309.

One typical example.

Acervulina inhaerens Schultze

Acervulina inhaerens Schultze 1854, p. 68, Plate VI, Fig. 12; Parr 1945, p. 214; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 368.

Several specimens. The species is widely distributed along the southern coastline of Australia, and occurs as far north as Geraldton in Western Australia.

Streblus beccarii (Linné)

Nautilus beccarii Linné 1758, p. 710, Plate I, Fig. 1 a-c.

Rotalia beccarii (Linné); Chapman and Parr 1935, p. 3; Logan 1959, p. 225, 259.

Streblus beccarii (Linné); Chapman 1941, p. 173; Parr 1945, p. 213; Parr in Fairbridge, 1950, p. 72.

This highly variable species is recorded spasmodically throughout Oyster Harbour. Its distribution extends from Bass Strait to Shark Bay.

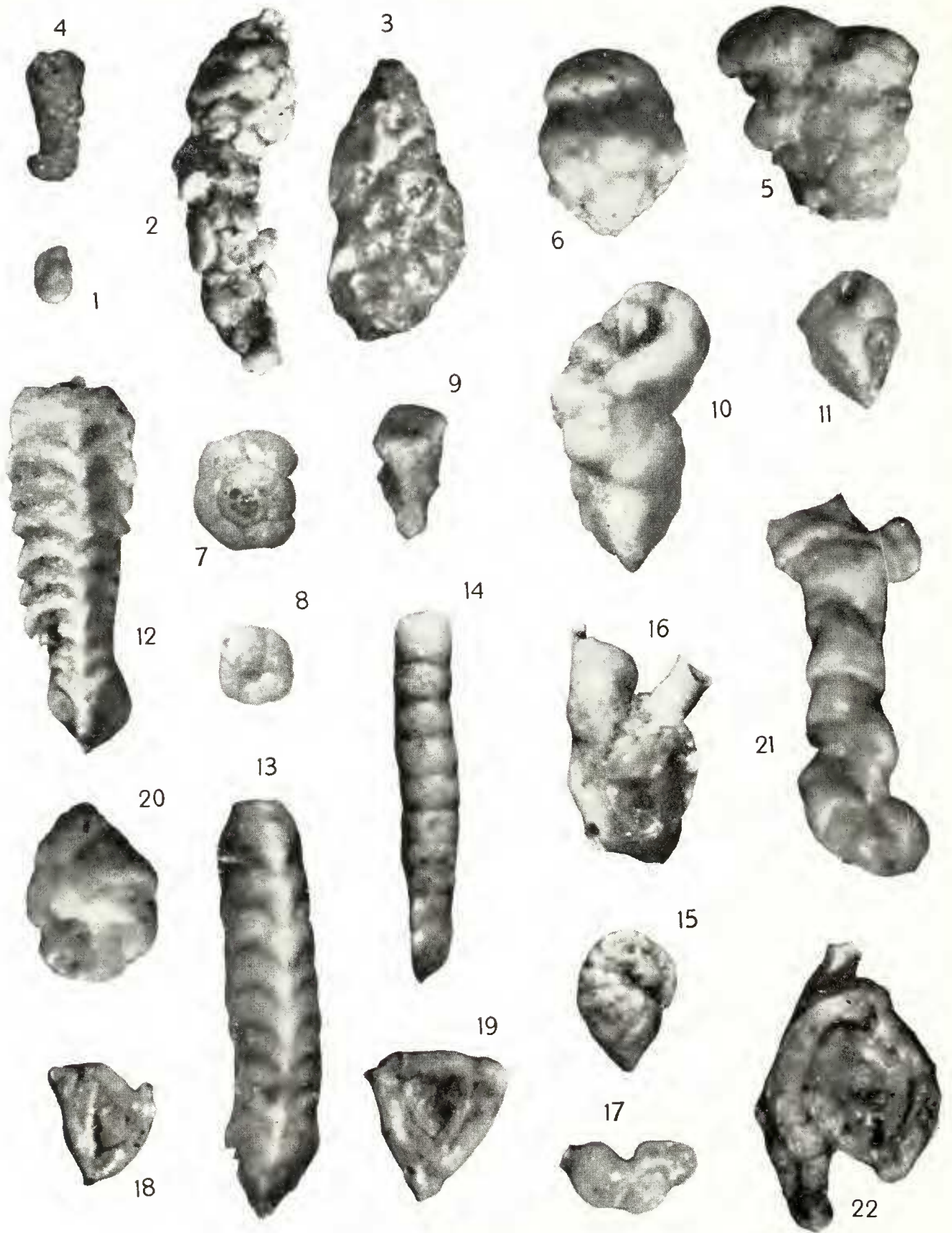


PLATE I

Rotalia trispinosa Thalmann = *Asterorotalia trispinosa* (Thalmann); Barker 1960, p. 238.

Rotalia pulchella Brady 1884, p. 710, Plate CXV, Fig. 8 a, b.

Rotalia trispinosa Thalmann 1933, p. 248; Asano 1951, part 14, p. 17, Fig. 127.

A characteristic Indo-Pacific species, but very rare in Oyster Harbour. It has also been recorded in Cockburn Sound, near Perth, Western Australia (R. A. McTavish personal communication).

Elphidium advenum (Cushman)

Polystomella advena Cushman 1922, p. 56, Plate IX, Figs. 11, 12.

Elphidium advenum (Cushman); Chapman 1941, p. 182; Parr 1945, p. 216; Parr in Fairbridge, 1950, p. 72; Logan 1959, p. 206, 241, Plate III, Fig. 16, Plate IV, Fig. 1.

Common in Australian waters, it occurs throughout Oyster Harbour, where it is the most abundant species.

Elphidium craticulatum (Fichtel and Moll)

Nautilus craticulatus Fichtel and Moll 1798, p. 51, Plate V, Figs. h-k, in an 1803 reprint.

Elphidium craticulatum (Fichtel and Moll); Chapman and Parr 1935, p. 2; Parr in Fairbridge, 1950, p. 72; Parr 1950, p. 373; Logan 1959, pp. 207, 241, Plate III, Figs. 14, 15.

The Australian records cited are all from Western Australian waters.

Elphidium crispum (Linné)

Nautilus crispus Linné 1758, p. 709, Plate I, Figs. 2 d-f (10th edition).

Elphidium crispum (Linné); Chapman and Parr 1935, p. 2; Chapman 1941, p. 182; Parr in Fairbridge, 1950, p. 72; Logan 1959, pp. 208, 242, Plate IV, Figs. 2, 3.

Common in southern Australian waters. This species apparently cannot tolerate the brackish conditions in the northern part of Oyster Harbour.

Elphidium incertum (Williamson)

Polystomella umbilicatulata (Walker) var. *incerta* Williamson 1858, p. 44, Plate III, Fig. 82a.

Elphidium incertum (Williamson); Parr in Fairbridge, 1950, p. 72; Parr 1950, p. 373.

Previously recorded off Albany, this species is common in Oyster Harbour.

Elphidium jenseni (Cushman)

Polystomella jenseni Cushman 1924, p. 49, Plate XVI, Fig. 6.

Elphidium jenseni (Cushman); Chapman 1941, p. 182; Parr 1950, p. 372.

Known to occur off the coast of New South Wales, in Bass Strait and off Tasmania. Differentiated by its finely papillate umbilical area from *Elphidium macellum* (Fichtel and Moll), in which this feature is not present.

Elphidium laminatum (Terquem)

Polystomella laminata Terquem 1878, p. 16, Plate I, Fig. 8 a, b.

Rarely recorded, this species can be taken for an *Operculina* but the retral processes are quite

distinct. It is characteristically highly compressed. Present near the southern entrance to Oyster Harbour.

Elphidium macellum (Fichtel and Moll)

Nautilus macellus Fichtel and Moll 1798, pp. 66, 68, Plate X, Figs. e-k, in an 1803 reprint.

Elphidium macellum (Fichtel and Moll); Chapman 1941, p. 183; Parr 1945, p. 216; Parr in Fairbridge, 1950, p. 72; Parr 1950, p. 372.

Common in southern Australian waters from Bass Strait to Perth.

Ozawaia tongaensis Cushman

Ozawaia tongaensis Cushman 1922, p. 80, Plate X, Figs. 7-10.

This Pacific species is very rare in Oyster Harbour.

Elphidiononion sp. aff. **simplex** (Cushman)

Elphidium simplex Cushman 1933, p. 52, Plate XII, Figs. 8, 9; Logan 1959, pp. 208, 243, Plate IV, Fig. 5.

Elphidiononion sp. aff. *simplex* Cushman; Parr 1945, p. 216, Plate XI, Fig. 8.

Parr describes a form, from Barwon Heads, Victoria, in which the retral processes are more prominent than in Cushman's species. The Oyster Harbour specimens resemble Parr's in this respect. The author follows Vella (1957, p. 38) in the use of the generic name *Elphidiononion*.

Globorotalia scitula (Brady)

Pulvinulina scitula Brady 1882, p. 716.

Globorotalia scitula (Brady); Chapman 1941, p. 181; Parr 1950, p. 367.

One example of this widely distributed pelagic species.

Globigerina bulloides d'Orbigny

Globigerina bulloides d'Orbigny 1826, p. 277; Chapman and Parr 1935, p. 3; Chapman 1941, p. 179; Parr 1945, p. 215; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 365.

There were several specimens from Oyster Harbour of this universally distributed pelagic species.

Orbulina universa d'Orbigny

Orbulina universa d'Orbigny 1839, p. 3, Plate I, Fig. 1; Chapman and Parr 1935, p. 3; Chapman 1941, p. 180; Parr 1945, p. 215; Parr 1950, p. 366.

Another pelagic species with world-wide distribution. One small example was found in Oyster Harbour.

Discanomalina sp.

This resembles *Anomalina colligera* Chapman and Parr, known from Bass Strait to the Bight (Chapman and Parr 1935, Chapman 1941, Parr 1950). The large area of clear shell material in the umbilical region of the ventral side, however, places it in *Discanomalina*.

PLATE I*

1: *Miliammina fusca* (Brady) x 20; 2: *Reophax scorpiurus* Montfort x 30; 3: *Nouria polymorphinoides* Heron-Allen and Earland x 30; 4: *Ammobaculites agglutinans* (d'Orbigny) x 20; 5: *Textularia candeiana* d'Orbigny x 30; 6: *T. conica* d'Orbigny x 30. Apertural view 7: *Trochammina inflata* (Montagu) x 30. Dorsal view; 8: *T. inflata* x 30. Ventral view; 9: *Gaudryina (Pseudogaudryina) hastata* (Parr) x 30; 10: *G. triangularis* Cushman x 30; 11: *G. triangularis* Cushman var. *angulata* Cushman x 30; 12: *Clavulina difformis* Brady x 30; 13: *C. pacifica* Cushman x 30; 14: *C. serventyi* Chapman and Parr x 30; 15: *Cribrobulimina polystoma* (Parker and Jones) x 20; 16: *Nubecularia lucifuga* Defrance x 30; 17: *Parrina bradyi* (Millett) x 30; 18: *Spirothamidium concentricum* (Terquem and Berthelin) x 30; 19: *S. concentricum* x 30. Costate variety; 20: *Vertebralina striata* d'Orbigny x 30; 21: *V. sp.* x 30; 22: *Ptychomiliola separans* (Brady) x 30.

* All photographs taken by the author using a Leica Reprovis II and microfilm, developed and printed by K. Bauer.

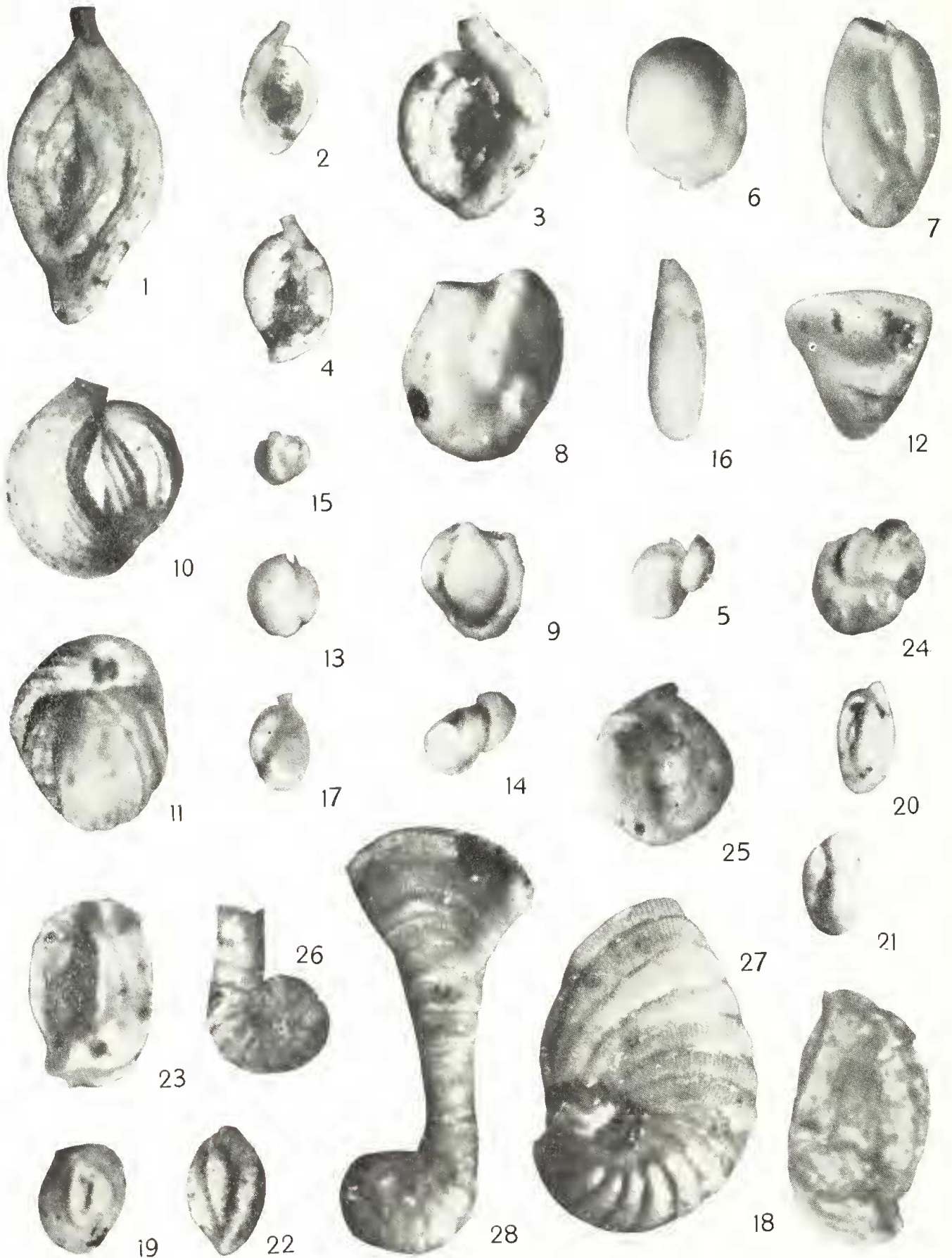


PLATE II

1: *Spiroloculina antillarum* d'Orbigny x 30; 2: *S. canaliculata* d'Orbigny x 30; 3: *S. hadai* Thalmann x 30; 4: *S. milletti* Wiesner x 30; 5: *Planispirinoides bucculentus* (Brady) x 30; 6: *Pyrgo fornasinii* Chapman and Parr x 30; 7: *Triloculina lacvigata* d'Orbigny x 30; 8 and 9: *T. rotunda* d'Orbigny x 30. Both sides; 10 and 11: *T. striatotrigonula* (Parker and Jones) x 30. 11 is an apertural view; 12: *T. trigonula* (Lamarck) x 20. Apertural view; 13: *Miliolinella circularis* (Bornemann) x 20; 14: *M. labiosa* (d'Orbigny) x 30; 15: *Sigmoilina australis* (Parr) x 20; 16: *Quinqueloculina bosciana* d'Orbigny x 30; 17: *Q. costata* d'Orbigny x 30; 18: *Q. granulocostata* Germeraad x 20; 19: *Q. lamarckiana* d'Orbigny x 30; 20 and 21: *Q. seminula* (Linne) var. *longa* Gherke x 30. Both sides; 22: *Q. subarenaria* Cushman x 30; 23: *Q. subpolygona* Parr x 30; 24: *Pseudomassilina australis* (Cushman) x 30; 25: *Massilina secans* (d'Orbigny) var. *tenuistriata* Earland x 30; 26: *Spirolina cylindracea* (Lamarck) x 30. Broken specimen; 27: *Peneroplis planatus* (Fichtel and Moll) x 30; 28: *P. sp.* x 30.

Anomalina glabrata Cushman

Anomalina glabrata Cushman 1924, p. 39, Plate XII, Figs. 5-7; Chapman and Parr 1935, p. 3; Chapman 1941, p. 175.

One very small example of this species, which has also been recorded from Bass Strait and the Bight.

Cymbalopora poeyi (d'Orbigny) = *Cymbaloporetta squamosa* (d'Orbigny); Barker 1960, p. 210.

Rosalina poeyi d'Orbigny 1839, p. 100, Plate III, Figs. 18-20.

Cymbalopora poeyi (d'Orbigny); Brady 1884, p. 637, Plate CII, Fig. 13.

One small example of this widely distributed shallow water species.

Cymbaloporetta bradyi Cushman

Cymbalopora poeyi var. Brady 1884, p. 637, Plate CII, Fig. 14 a-d.

Cymbaloporetta bradyi Cushman 1931, p. 75; Logan 1959, pp. 228, 238.

One typical example of this species, which is also recorded by Logan from Shark Bay.

Tretomphalus bulloides (d'Orbigny) = *Tretomphalus planus* Cushman; Barker 1960, p. 210.

Rosalina bulloides d'Orbigny 1839, p. 98, Plate III, Figs. 2-5.

Cymbalopora (Tretomphalus) bulloides (d'Orbigny); Brady 1884, p. 638, Plate CII, Figs. 7-12.

Tretomphalus cf. *bulloides* (d'Orbigny); Logan 1959, p. 228.

In the majority of the Oyster Harbour examples the characteristic, final balloon-like chamber has been ruptured. Two specimens, however, retain it, enabling the ruptured individuals to be associated with the species by a comparison of their earlier rotaliform stages, which in all but one of the specimens have a reddish-brown colour. The exception is white.

Parr (1945, p. 212, Plate XI, Figs. 4, 5) has figured as *Tretomphalus concinnus* (Brady) from Barwon Heads, Victoria, forms similar to those which this author has assigned to *T. bulloides* after a study of d'Orbigny's and Brady's descriptions and figures. Logan has recorded from Shark Bay a *Tretomphalus* which he compares with *T. bulloides*.

Carpenteria sp.

Two juvenile specimens referable to this genus.

Virgulina cf. *schreibersiana* Czjzek

Virgulina schreibersiana Czjzek 1848, p. 147, Plate XIII, Figs. 18-21; Parr 1945, p. 205; Parr in Fairbridge, 1950, p. 71.

One specimen. This record has an added significance because Oyster Harbour is intermediate between Barwon Heads, Victoria, and Geraldton Harbour, Western Australia, where the species is already known to occur.

Nonion depressulum (Walker and Jacob)

Nautilus depressulus Walker and Jacob in Kanmacher, 1798, p. 641, Plate XIV, Fig. 33.

Nonion depressulum (Walker and Jacob); Chapman 1941, p. 181; Parr 1945, p. 215.

Several specimens, thus extending the known distribution of this species into Western Australian waters.

Cibicides lobatulus (Walker and Jacob)

Nautilus lobatulus Walker and Jacob in Kanmacher, 1798, p. 642, Plate XIV, Fig. 36.

Cibicides lobatulus (Walker and Jacob); Chapman and Parr 1935, p. 3; Chapman 1941, p. 176; Parr 1945, p. 214; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 364; Logan 1959, p. 230.

Frequently encountered in Oyster Harbour this species is widely distributed in southern Australian waters from Bass Strait to Shark Bay.

Cibicides pseudoungerianus (Cushman)

Truncatulina pseudoungerianus Cushman 1922, p. 97, Plate XX, Fig. 9.

Cibicides pseudoungerianus (Cushman); Chapman 1941, p. 176; Parr 1950, p. 365.

Common in southern seas. On the southern eastline of Australia it has been recorded off Tasmania and near Albany.

Cibicides refulgens (Montfort)

Nautilus (Rotalia) refulgens Montfort 1808, p. 122.

Cibicides refulgens (Montfort); Chapman and Parr 1935, p. 3; Chapman 1941, p. 177; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 363; Logan 1959, pp. 230, 236.

This universally distributed species is common in Oyster Harbour.

Cibicides tenuimargo (Brady)

Truncatulina tenuimargo Brady 1884, p. 662, Plate XCIII, Figs. 2, 3; Heron-Allen and Earland 1915, p. 707.

Four of Brady's localities are in eastern Australian waters. Oyster Harbour is intermediate between his records and those of Heron-Allen and Earland from the Kerimba Archipelago, making this occurrence of particular interest.

Dyocibicides biserialis Cushman and Valentine

Dyocibicides biserialis Cushman and Valentine 1930, p. 31, Plate X, Figs. 1, 2; Chapman 1941, p. 177.

Distinguished by the limbate, slightly raised sutures on its flattened face. Chapman has recorded it off south-eastern Australia.

Dyocibicides cf. *perforata* Cushman and Valentine

Dyocibicides perforata Cushman and Valentine 1930, p. 31, Plate X, Fig. 3 a-c; Asano 1951, part 13, p. 19, Fig. 50.

Sutures initially limbate and flush, but later non-limbate and slightly depressed. One example.

Spirillina inaequalis Brady

Spirillina inaequalis Brady 1879, p. 278, Plate VIII, Fig. 25 a, b; Chapman and Parr 1935, p. 2; Chapman 1941, p. 157; Parr 1945, p. 199; Parr in Fairbridge, 1950, p. 71; Parr 1950, p. 350.

Only one example of this well-known Indo-Pacific species, recorded in southern Australian waters from Bass Strait to Geraldton Harbour, was found in Oyster Harbour.

This completes the notes on the species. Specimens are stored at the Geology Department, in the University of Western Australia.

Conclusions

The value of foraminifera in environmental studies has been conveyed to some extent in the preceding discussions on the species. It must be realised, however, that they comprise only a single element in the complex biotope of the Harbour, and the ecological information they

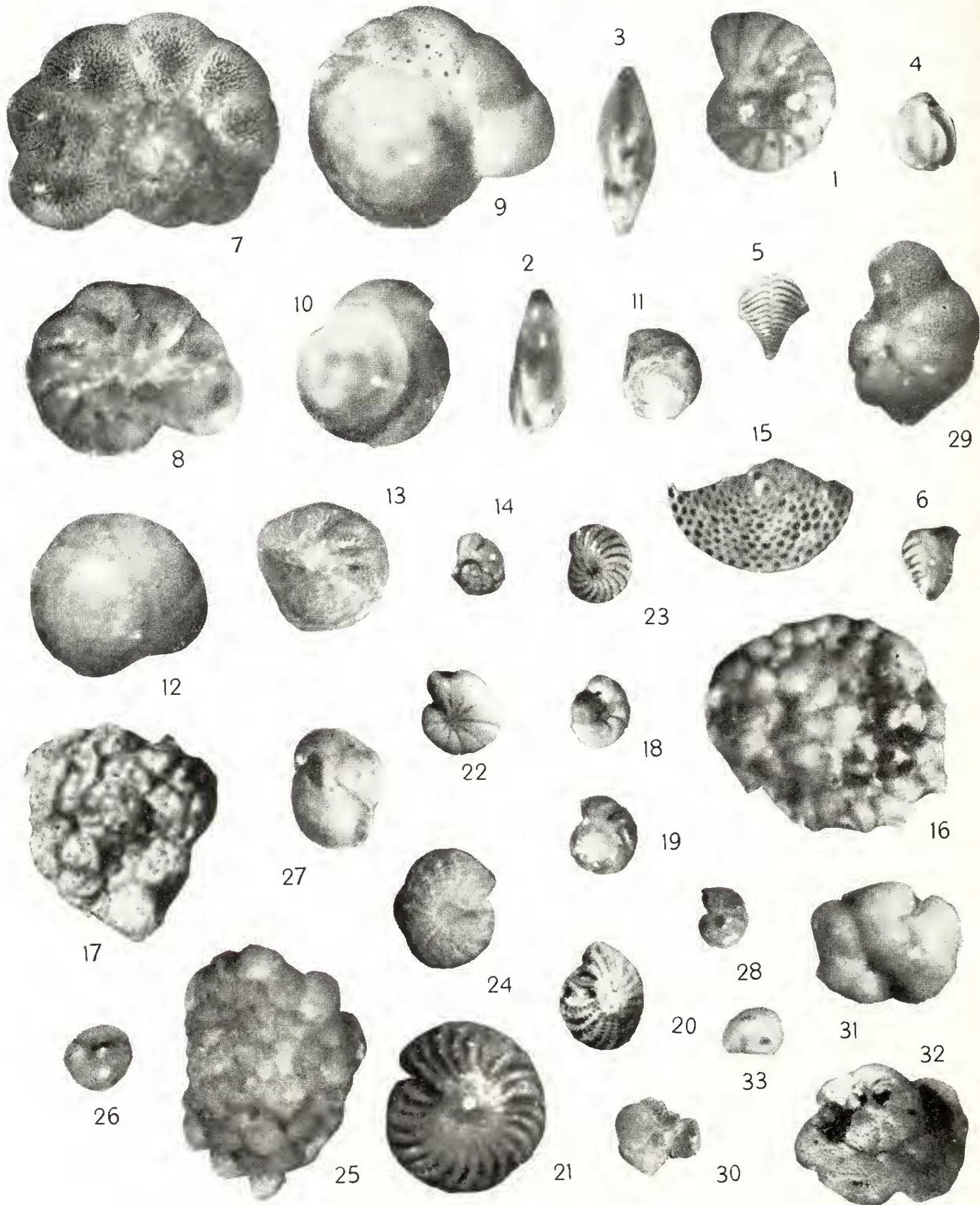


PLATE III

convey must be integrated with that provided by the other groups now being studied (ostracods, echinoids, molluscs and weeds.)

The complexity of the other factors which control environment must also be emphasised. Of these, depth of water has been indicated by the depth contours on the sample location map; others which are important include the hydrologic regime (pH, Eh, chlorinity, temperature, phosphate and nitrate content), the lithotope, and climate, as well as abundance and type of competing plant and animal life.

To illustrate this complexity consider the hydrologic regime. Each of the components studied has a seasonal fluctuation, quite marked in some instances (temperature and chlorinity), but small in others (phosphate and nitrate content). The regime is the totality of these fluctuating components (and others which the author has been unable to study but which are generally considered of less significance), and the effect of any one of them on the environment can be considered only with reference to the hydrologic regime as a whole.

Similarly, the lithotope can be size-sorted and also sub-divided into its quartz-felspar, carbonate, organic matter, heavy mineral and clay fractions, which can then be analysed separately. As the size and proportions of these fractions vary so the lithotope alters, and again, the effect of any one fraction on the environment must be considered in relation to the lithotope as a whole at the location being studied.

The variables which determine climate are too well known to require elaboration here, and the same principle applies: that it is the interaction of these variables which determines climate, and therefore, that the effect of one of them on the environment must be determined with respect to its part in the climate as a whole.

Not only are the factors considered above complex within themselves, but they are complexly interwoven into the fabric which defines the environment. The environment is their ultimate expression.

A study of the environment, however, is not the purpose of this paper which is concerned with the identification of the species encountered in the samples examined and with their corrected nomenclature, and which is primarily a record of species occurrence; but the author intends to submit a separate paper in which the environments in Oyster Harbour will be analysed, and the complexities present, if not unravelled, at

least clearly stated, and in which the foraminifera will have their place, among the other components of the biotope, as indices of environmental change.

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Dr. P. J. Coleman, of the Geology Department, University of Western Australia, suggested useful alterations to the form of the manuscript.

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PLATE III

- 1: *Panoropsis pertusus* (Forsk.) x 30; 2: *Guttulina cf. lactea* (Walker and Jacob) x 30; 3: *G. yabei* Cushman and Ozawa x 30; 4: *Sigmoidella elegantissima* (Parker and Jones) x 30; 5: *Bolivina folium* (Parker and Jones) x 30; 6: *Reussella ensiformis* (Chapman) x 30; 7: *Discorbis dimidiatus* (Jones and Parker) x 30. Dorsal view; 8: *D. dimidiatus* x 30. Another specimen; ventral view; 9: *D. dimidiatus* (Jones and Parker) var *acervulinoides* Parr x 30; 10: *D. mira* Cushman x 30; 11: *D. opercularis* (d'Orbigny) x 30; 12: *Eponides repandus* (Fichtel and Moll) x 30. Dorsal view; 13: *E. repandus* x 30. Another specimen; ventral view; 14: *Discorbinella biconcava* (Jones and Parker) x 30; 15: *Marginopora vertebralis* Quoy and Galmard x 30. Broken specimen; 16: *Planorbulina acervalis* Brady x 30; 17: *Planorbulinella larvata* (Parker and Jones) x 30; 18: *Streblus beccarii* (Linné) x 30. Ventral view; 19: *S. beccarii* x 30. Another specimen; dorsal view; 20: *Elphidium advenum* (Cushman) x 30; 21: *E. crispum* (Linné) x 30; 22: *E. incertum* (Williamson) x 30; 23: *E. laminatum* (Terquem) x 30; 24: *E. macellum* (Fichtel and Moll) x 30; 25: *Planorbulina rubra* d'Orbigny x 30; 26: *Tretomphalus bulloides* (d'Orbigny) x 30; 27: *Carpenteria* sp. x 30; 28: *Nonion depressulum* (Walker and Jacob) x 30; 29: *Cibicides lobatulus* (Walker and Jacob) x 30. Dorsal view; 30: *C. pseudoungerianus* (Cushman) x 30. Ventral view; 31: *C. tenuimargo* (Brady) x 30. Dorsal view; 32: *C. tenuimargo* x 30. Ventral view; 33: *C. refulgens* (Montfort) x 30. Dorsal view.

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